THE PROGRESSIVE FISH CULTURIST

NEWS AND VIEWS FROM MANY SOURCES ON PRACTICAL HATCHERY PROBLEMS

ISSUED BY THE

U. S. DEPARTMENT OF COMMERCE
DANIEL C. ROPER, SECRETARY

BUREAU OF FISHERIES
FRANK T. BELL, COMMISSIONER

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THE PROGRESSIVE FISH CULTURIST

A SERIAL memorandum published occasionally for the advancement of Federal, State, and private fish culture and fishery management in fresh waters.

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BUREAU OF FISHERIES U. S. DEPARTMENT OF COMMERCE

Memorandum I-131 Washington, D. C., November 1937 No. 33.

GOOFY BUSINESS: IS FISHERY CONSERVATION BUSINESSLIKE?

By Russell F. Lord, In Charge,
U. S. Bureau of Fisheries Experimental Trout Hatchery,
Pittsford, Vermont.

THE SCENE is one of those grocery stores sometimes called "grocerterias", where the customer goes about the shelves with a basket on his arm to make his own selections.

Listen then to this crazy conversation between a customer who is ready to pay his bill and the manager:

Customer: (Setting a filled basket on the counter before a sleepy-looking individual). "Guess that does it. What do I owe you?"

Manager: "You live in town?"

Customer: "Why yes."

Manager: "Dollar."

Customer: "But, look here! I've more than a dollar's worth."

Manager: "Don't care." (He turns aside as a woman walks up to the booth). "That's right, lady, just one dollar."
(The lady purchaser walks away with a full creel, oops! our error, we mean basket, but the first man is still too mystified to let the conversation stop at this point. He continues.)

Customer: "You mean, you just charge everyonea dollar no matter how full the baskets are?"

Manager: "Sure, they live here, don't they?"

Customer: (Thinking he is in the craziest place he has ever been in) "But what about the business? How in the world do you keep going? Surely it won't last long at this rate!"

Manager: (Yawning) "Oh, they keep saying all the time it's harder to get what they want, but nobody seems to care about next year as long as they can get a little something now."

Customer: "That seems a crazy way to run a business. Why don't you make a change? Don't you keep any sort of sales record?"

Manager: "Nope."

Customer: "But the stocking - How do you know what sort or how much stuff to put on the shelves unless you keep a record of the sales?"

Manager: "Can't be bothered with all that. I just take their dollars and stock up with any old thing I can get the cheapest."

Customer: (Getting excited) "Then you have no idea at all what the customers are carrying off in their baskets? You don't know how your stock is holding up?"

Manager: "Nope."

Customer: "I can't believe it!"

Manager: "Oh, well, most of these stores are run the same way."

Customer: (To himself) "Not even a sales record - one dollar - I'm going crazy too!"

Manager: (Suddenly) "Charge 'em more if they don't live here. Help some."

Customer: (Sarcastically) "Now isn't that nice."

Manager: "Oh sometimes I get to thinking I ought to check up, but nobody ever has."

Customer: "Well, if there isn't some change made the customers won't find much left for their baskets. The shelves look sort of empty now!"

Manager: (Yawning again) "Maybe you're right, but they like it this way." (He turns to another basket holder) "Yes, sir, just one dollar"

Customer: (Leaving in a dazed condition) "Good Lord, what a way to run a business!"

Far fetched as it might sound at first, there is a lamentable similarity between the managing of today's trout fishing and the managing of "Goofy Groceries, Inc." You and I are the customers. We pay a dollar and take from the shelves all we can get into our baskets. We visit the streams with the hope of bringing home a creel of trout, but we are even better off than the customers of the grocery store, for should we find the "shelves" empty of what we want, we can make a hundred or more trips to the "store" - all on the same dollar.

The Fish and Game Department occupies the manager's shoes in "Goofy Groceries, Inc." It accepts our dollars and stocks the "shelves" with whatever trout can be reared and planted for the least expense. Like the other manager, the department never knows how much of the stock is being carried off in the baskets of the customers. It has no idea how much spoils on the "shelves" due to natural causes or improper handling. About the only effort the management has made to safeguard the business is to see that officers are sometimes around to prevent outright thievery. It seems, however, that with so little check on honest customers, the work of the wardens only delays the day when the company must go broke. If the Manager of "Goofy Groceries, Inc." is trying to get along without a sales record, what about the usual Fish and Game Department?

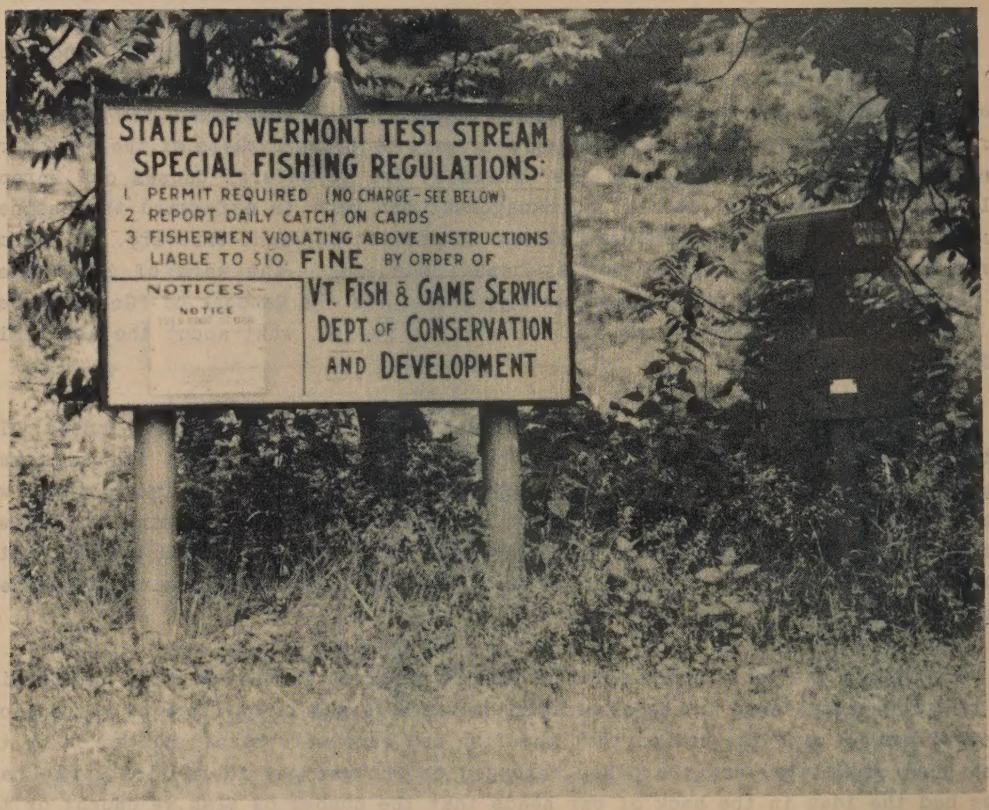
Up until quite recently any sort of "sales record" has been a rarity indeed. The usual Fish and Game Department has been busy putting out fish, but it was a rare thing when there was any accurate idea of what percentage of the fish planted was actually taken by the anglers. In fact, it was unusual when anything at all was known about <u>any</u> fish taken by the anglers - let alone those planted by the State. It does not take an efficiency expert to point out the flaws in this kind of business management.

Very likely the real reason for the lack of progress is that hunting and fishing have long been considered not as a business but as a very personal form of recreation. We have grown up with the notion that the fish and game were placed before us by the lavish hand of Nature, and that they belonged to whoever got there first. We have always had the idea in the back of our heads that the number of fish we caught or the amount of game we killed was our own personal business.

In the old days if a man found someone else ahead of him at his favorite stream or covert he could always find a new, unspoiled territory to exploit. Today, the chance of an angler finding himself alone on a brook is as rare as a shower of dry rain. To provide even fair hunting and fishing for today's army of hopefuls is a real job, calling for real cooperation between the "manager" and the "customer" if success is to follow. But, if the anglers continue to fish the way they do these days, and state departments continue to stock streams without knowing what the waters are producing, such management is no better than that portrayed by "Goofy Groceries, Inc."

The need for a continuous check-up on fishing results is so obvious that people are beginning to be aroused, and such organizations as private fishing clubs, state departments of conservation, and the Federal Bureau of Fisheries are inquiring more closely about the relation between the number of fish taken and the number planted.

In Vermont, for example, a "test water" program has been initiated for the purpose of getting detailed information on the production of fish in some representative trout waters. A law was enacted which allows four different bodies of water in the state to be set aside at any one time for such a program. It is hoped that a much clearer understanding of the modern trout fishing problem will result.


STATE OF VERMONT TEST STREAM
SPECIAL FISHING REGULATIONS:
1 PERMIT REQUIRED (NO CHARGE - SEE BELOW)
2 REPORT DAILY CATCH ON CARDS
3 FISHERMEN VIOLATING ABOVE INSTRUCTIONS
LIABLE TO $10 FINE BY ORDER OF
NOTICES
NOTICE
VT. FISH & GAME SERVICE
DEPT. OF CONSERVATION
AND DEVELOPMENT

Notice and mail box where anglers deposit records of fishing on Furnace Brook, Vt. This notice is placed on the main road at the lower end of the test section. Mail boxes are placed at convenient points along the stream.

The machinery for securing the angling statistics is simple. Persons fishing "test waters" are required by law to fill in cards giving the results of each day's fishing (the "fishing effort"), and to leave these filled cards in certain designated conveniently located mailboxes. Cards and pencils can be found in the boxes. The project is cooperative between the State of Vermont and the U. S. Bureau of Fisheries, the former enforcing the "test water" regulations and the latter carrying on the necessary research and stocking. Meanwhile, a careful study of the trout food conditions is being made on each test stream.

Here, then, is a case where the "customers" and the "management" are working together to see what can be done to improve the business. Not only is the manager keeping an accurate "sales record," but every customer must help out with the bookkeeping. In other words, the business has become cooperative in fact as well as in theory. Each customer may criticize the business and offer helpful suggestions if he desires. And a good many do, too. Let us take a look at some of the "remarks" on the 1936 report cards from Furnace Brook.

June 24, 1936 - "This brook is fished out. Why don't you stock it and post it for three or four years?" This customer evidently had such a poor opinion of the available stock that he thought all efforts for the next few years should be devoted to replacing goods rather than making sales.

June 27, 1936: "Poor Fishing." Here is another dissatisfied customer. He did spend two hours looking over the shelves and found just one six-inch fish to go home in his basket. Perhaps we should excuse his frame of mind.

June 28, 1936: "Good." By this terse word we can believe that the customer went home quite satisfied, as well he should, for the basket held 10 nice trout after two hours' shopping.

June 28, 1936: "Plenty trout - fine work on trout bed." This person spent four hours casting a fly and took seven trout. He was one who used his eyes too, for the allusion to the "trout bed" referred to some recent stream improvement by the Government.

July 2, 1936: "Biggest brook trout I have caught up here in five years." We know he went home a happy man for his creel contained 24 brook trout ranging from six to 10 inches, and one seven-inch rainbow - a limit catch under the Vermont laws.

July 4, 1936: "Mosquitoes biting fine. Trout are pixilated."

July 9, 1936: "Pretty good." This modest fisherman had just succeeded in apprehending 10 rainbows and three brook trout after three hours' fishing.

July 24, 1936: "Fishing good." There was no hesitation here! Not when three hours of fishing, yes, with the humble worm, resulted in a creel sagging comfortably with the limit catch - 10 rainbows and 15 brooks. A very nice dollar's worth, indeed!

July 25, 1936: "Punk." Well, well! Just one day later and an entirely different point of view. This man reported returning 100 short trout to the water while collecting eleven 6-1/4 inch brook trout for the pan. Did HE paw the stock around!

August 4, 1936: "First attempt at dry fly fishing. Experienced man could have caught more." Here is a fisherman who practiced with a dry fly for nine hours and while learning, managed to remove three rainbows and six brook trout. That ought to make another convert to the most aristocratic form of trout deception.

August 4, 1936: "Put in more natives." This person went after brook trout in a great big way, for he found that grasshoppers, properly presented, brought him a limit catch of 24 brook trout and one rainbow. He evidently wants to repeat the stunt and is a little worried about the supply!

August 14, 1936: "No water." On the last fishing day of the season we get a complaint on low water conditions from an angler who thought that three brook trout and one rainbow were not a suitable reward for two hours' exercise with a dry fly.

And so it went. Some thought business was fine and some thought it was terrible, but every customer set down a figure representing what goods went home in his basket! That is the essential thing! If all the remarks and suggestions made by elated or disgruntled anglers were taken at their face value, the idea of fishing conditions would be very confused indeed.

In fact, if our knowledge of the 1937 fishing in Furnace Brook depended upon mere remarks, we would be completely in the dark. Why? Just because the report cards have been revised and it is now necessary for anglers to turn them over and write their notions on the reverse side! Out of almost a thousand fishermen who filled out cards on Furnace Brook this past season, only a dozen felt they could spare the time to write on the backs. The catch records, however, were adequate. So then, the management very wisely discounts opinions, and consults the "sales record", the only way to secure an unbiased and impersonal knowledge of the business.

It is not the intention of the writer to inflict upon the reader a long list of figures which must be studied by the management for the good of future business. It is enough here to just touch upon the outstanding facts in one of the places under observation - Furnace Brook once more. First of all, the yearly bookkeeping from 1935 to 1937 showed that the trout fishing business is "big business," for we found from 938 to 1,107 customers trading at just one store. In the 106 days that the places were open for business each summer, they took away from 8,589 to 6,385 trout. Second, it appears that the method of keeping the "sales record" is very efficient. An examination of the baskets revealed a welcome consistency in the average contents.

Average Number of Trout Per Fishing Effort.

	May	June	July	August (2 weeks)	Season
1935	6.5	8.0	8.0	7.5	7.2
1936	6.2	6.3	6.3	7.2	6.3
1937	5.8	6.6	8.6	7.5	6.5

Such results show that the customers had the good fortune to be trading at a store where the shelves held enough goods to make it worth while to continue coming there throughout the summer.

The chief thing that the manager learned is how hard it will be to keep enough stock on the shelves of the state stores to meet the demands of the future!

Since the start of the Vermont test water investigation, one stream has been under observation for three seasons, and one lake and two other streams for two seasons. Fishing results on all these waters have been, and will continue to be, carefully checked. The kind and amount of fishing found in these waters are sufficiently varied so that interesting comparisons can be made as the data accumulate.

The setup permits a very careful check on the fish taken. Results can be compared with stocking methods. Until the question of what happens to hatchery fish of various sizes after planting is satisfactorily settled, any scientific policy is out of the question.

For this reason the 1937 test water anglers were urged to be on the lookout for trout marked by removing certain fins, and to list the marked trout hooked. Unfortunately, however, the fact remains that anglers hate to be bothered, and to them a fish is a fish regardless of the number of fins it possesses. For example, a creel check on the first day of May this past season revealed that 33 percent of the trout in the baskets were marked fish which had been planted the previous fall. On the cards however the anglers reported a catch of only 16 percent marked trout - overlooking half. This did not represent dishonesty but carelessness, because the average number of trout per effort, regardless of fins, tallied exactly when report cards were checked against the creel inspections.

What happens to hatchery fish? Well, only 6½ percent of the marked brook trout yearlings planted in Furnace Brook prior to the 1937 fishing season were reported, and even if we conclude that this represents only half of the marked fish actually taken, the total comes to 13 percent. Such results emphasize the need of going after this essential information with adequate assistance and funds for really checking up on our trout production.

Thus, the test stream investigation is one attempt to remove the trout fishing business from the "Goofy Grocery" type of management. Now that it is planned to look long and carefully into some of today's baskets, it might happen that we can indefinitely put off the time when the customers must wander sadly around looking at empty shelves. Today's manager knows that he must stop yawning and tend to business, and the customers realize that it is not all up to the manager. Who knows - perhaps in time we can even change the name to "Ideal Cooperative Association."

It is an encouraging thing that present day anglers are realizing that some modification of the prevailing fishing regulations would do a great deal of good. Many sportsmen's organizations are favoring a smaller creel limit, a shorter season, and an increase in the license fee. Although certain individuals do not agree on all these points, almost everyone understands that the future of their sport rests upon sound management alone. In Vermont this past season the creel limit was reduced from 25 to 20 trout and the license fee raised from $1.00 to $1.25.

The ideal goal, of course, is to regulate every stream and pond visited by anglers as a separate, independent unit. When the millenium in trout management arrives we might expect to know just how many trout of a definite size to place at certain times of the year in any water.

This would be based upon the ability of the place in question to support the fish, and upon the amount of angling done. But before this ideal is achieved it is a fine thing to make a start in the right direction.

Practically every angler who was contacted in regard to his opinion of "test waters" was strongly in favor of the idea. A few went so far as to say, "They all ought to be test waters!" The investigation is therefore not only providing a great variety of information of value to the management of the waters under observation, but is showing every interested party that the future of trout fishing depends upon how well we follow today's slogan, "Let's check up!" or as we might put it, "Let's stop the Goofy Business!"

F E R T I L I Z A T I O N O F F I S H P O N D S I N C Z E C H O S L O V A K I A

By Edward B. Lawson, Commercial Attache,
U. S. Bureau of Foreign and Domestic Commerce.

(Note: The information in this report is largely based on a lecture given by Dr. A. Pytlik, Chief of the Czechoslovak Bureau of Fisheries and Hydrobiologics, at Doksy (Hirschberg) on July 26, 1935, and on the sources of information used by Dr. Pytlik, principally Dr. Demoll's book "Teichduengung". Numbers in parentheses in the text of this report indicate the sources on which the respective information is based. The reference numbers are listed at the end of the report.)

"The Land of the Thousand Lakes"

MORE THAN five hundred years of experience stand behind fish breeding in ponds in the Czechoslovak province of Bohemia. Most of the Czechoslovak fish ponds are in Southern Bohemia in the "land of the thousand lakes" around the city of Trebon (Wittingau) and most of the ponds are owned by the Government (5). According to 1934 returns (2) the 2,897 fish ponds in Czechoslovakia statistically covered in that year had a total area of 28,206 hectares and, in the same year yielded the following quantities of commercial size fish (metric tons): carp, 2,278; tench, 91; pike, 43; pike-perch, 16; trout and other salmonides, 9; eel, 0.3; and other fish, 17.3 metric tons.

Total Consumption of Fertilizers

In 1935 the following quantities of fertilizers were used in the statistically appraised fish ponds of Czechoslovakia (2).

Kind of Fertilizer	Metric Tons
Lime	1,327
Ground limestone	252
Superphosphates	301
Basic slag	41
Kainite	7
Potash	38
Stable manure	306
Liquid manure	157
Compost	480
Pond plants	370

The solid which forms the bottom of fish ponds in Czechoslovakia is, as a rule, very poor consisting largely of sand and the tributary brooks and creeks are biologically almost inactive. In spite of these adverse factors, fish raising especially of carp, is very highly developed and fertilizing plays an important part in pond economics. (1)

Take and Give (1)

Developments in agriculture, in the replacement of nutritive soil substances which have been taken out of the soil by annual crops, have to some extent been paralleled and the active substances of fishponds are being replaced. It is known that the active soil substances of ponds which do not have a regular inflow of fertilizing waters become exhausted and the yield of the ponds decline. According to the findings of Zuntz and Cronheim, about 1910, the natural feed supply of carp ponds must be maintained by means of fertilization in order to permit the carp to get the full benefits of artificial food. The food of the carp must be composed of at least one-fifth to one-third of low water fauna, the digestive enzymes of which help the carp digestive tract to absorb artificial feedstuffs.

The Biological Circle (1)

Inorganic nutritive substances must first be converted into subaqueous plant growths and then directly assimilated by the carp, or indirectly via low water organisms. The science of pond fertilization has therefore to reckon with these two elements in the biological circle. This holds true also of organic fertilizrs as only a very small percentage of organic fertilizer goes directly or through the short detour of water organisms into food for fish.

Denitrifying Bacteria (4)

The fertilization of ponds is made with the biological circle in mind. Water organisms that are of no use for the growth of fish or which are even harmful are suppressed. Denitrifying bacteria which grow in the water and mainly in the soil decompose nitrogenous substances and the nitrogen is released freely into the air, thus depriving the pond of one of the most important nutritive substances. The activity of these bacteria is counter-acted by taking care of a sufficient oxygen content of both water and soil. Also, the successful fish breeder knows the harmful organisms which either compete with the fish for food or are parasites on the fish.

The Oxygen Balance (4)

The yield of fish ponds is reported to be adversely affected by the so-called hard vegetation, i.e., plant growth reaching above the water surface which does not die and decompose in one vegetation period, such as reed and bull rush. They extract useful substances from the soil and moreover they create shade on the water surface. The contrary is true of the submerged water vegetation which as a rule, is not hardened by silicon salts. However, this so-called soft plant growth is not permitted to propagate to such an extent as to bar the entry of light and warmth into the water. This is one of the most important features of fish production methods and is based primarily on the need for an abundant development of the microvegetation and sufficient sunlight and warmth for its photosynthesis, the assimilation of carbon dioxide and the delivery of oxygen. For the oxygenation of the water it is not only important that the sun rays enter it unhampered, but also that the water come into direct contact with the air.

Reaction of Soil and Water (1)

A strong flow of water passing through a pond carries away useful substances and organisms. In such ponds good fertilizing returns are difficult to obtain even though the fertilizer be introduced in quiet spots and in quiet water. In the case of trout ponds it is regarded as advisable to shut off the passing current of water for at least five to seven days after the fertilization has taken place, thus permitting the bottom soil to absorb the active substances from which they gradually enter the water. As the useful water organisms do not stand a sour reaction it is important to insure, prior to fertilizing a neutral or weak alkaline reaction of water and soil.

In view of the aforementioned reactions it is absolutely necessary to have a thorough knowledge of the chemical and physical properties of the soil prior to the fertilization. An excessive permeability of the bottom soil is inadvisable as organic substances filter into deep strata and are lost for fish production purposes. Such ponds must be fertilized with easily soluble fertilizer which are assimilated by the subaqueous vegetation before they can filter through the soil.

Soil and Fertilizer (1, 4)

The kind of bottom soil is especially important in carp ponds as the carp feeds largely on the fauna near the ground and of decomposing organic matter in the higher layers of the bottom mud. These biologically active higher strata of the mud - the solid lower parts of the soil having no direct influence on fish production - must be rich in oxygen and permit the growth of nitrification bacteria which assimilate the nitrogen in the water into the albumin of their bodies. Such active mud is rich in plancton. In order to maintain such a healthy bottom surface it is necessary, once in several years, to let the pond go dry for a summer or at least to have it dry over the winter once in several years.

The soil thus maintains its absorptive qualities, which is extremely important for the fertilizing process. The absorptive quality is especially pronounced in the case of phosphorous fertilizers. It is considered necessary therefore that in order to obtain an immediate fertilizing effect with phosphate fertilizers, to introduce a quantity large enough to insure an excess of fertilizer over the quantity absorbed by the bottom soil. High absorptive qualities are found in clay argilaceous and clay-sand soils which are rich in humus. Potash is reported to be not as readily absorbed as phosphoric acid. Nitrate in the form of ammonia is readily absorbed but only very little in the form of nitric acid. Losses may therefore result from the use of nitrogenous fertilizers, as ammonia is readily transformed into nitric acid which filters to deeper soil strata and is lost.

The Circulation of Fertilizers

Tests carried out by Dr. Breest on pond fertilization with potassium chloride showed that after three weeks one half of the fertilizer was absorbed by the surface of the bottom mud, the balance had largely filtered to deeper strata, only a small fraction being dissolved in the pond water. While these figures do not apply to all kinds of fertilizing, they are instructive. The active strata of the bottom mud was only about 15 inches deep. The formation of deeper mud had an adverse effect on the fish growth because denitrifying bacteria thrive in a greater depth.

The Law of Minima and Maxima (1, 4)

The fertilization is largely carried out with the pond filled with water. It must be said here that no data yet exist as to the exact importance of the "production chain" of a fish pond, i.e., inorganic matter, plancton, low fauna and fish, and the production process must be therefore largely guided by the results and data gained on the growth of fish in proportion to fertilizing and by tests carried on in individual ponds, starting always with the smallest pond at hand. To obtain a reliable check, in the opinions of some, it is necessary to know the production of the non-fertilized ponds for a period of at least three years and to maintain non-fertilized "control ponds". For reasons of comparison this must be done without any artificial feeding of the fish in either pond. The test and control ponds are to be populated with an adequate number of fish (gauging conservatively the expected quantitative growth).

Fertilizers

The following gives a digest of the opinions of several persons, on the use of the more important fertilizers, i.e., those to prevent minima to occur in nitrogen, lime, phosphorus, potash and carbon.

Nitrogenous Fertilizers (1, 3, 4)

The best, because balanced, but also most expensive fertilizer is liquid and stable manure; aged manure is preferable to the fresh. Cattle and hog manure is the best, manure from horse stables not being as good. Liquid manure, fecals, bone and fish meal are relatively expensive fertilizers. The over-water vegetation of fish ponds is useable for fertilizing purposes only after the cellulose is completely fermented which may be reached by aging with liquid manure and lime. The occasional planting of the dry bottom of the pond with green plants such as lupines, vetches, peas, oats or meadow grass is recommended. Before plowing the bottom, basic slag and kainite (about 200 kilograms per hectare) are spread and after the plowing 500 kilograms of marl is spread and then the "field" planted but only with about one-third the quantity of seed customary for a field of the same quality. Before the plants can form seed, the pond is filled with water and the dying and decomposing plants bring about the fertilizing effect. Also industrial waste rich in organic matter may be used such as yeast, molasses, spent beet liquor, etc. As these substances require large amounts of oxygen their use should be restricted to ponds if and when they are left dry over the winter.

A shortage of nitrogen exists in ponds with a sandy bottom or in those with bottom composed of limestone-pebble. Organic fertilizers should be used. Inorganic nitrogenous fertilizers have not stood the time test in view of the activity of the denitrification bacteria which make the nitrogen of these fertilizers "disappear" quickly.

Carbon (1, 4)

Fish ponds receive carbon in the form of carbohydrates, i.e., either stable and similar manure or composted water plants, using largely the "hard" vegetation of the pond. This fertilization for carbon is necessary in ponds containing little humus in their soil, mainly if the bottom is sandy.

Lime (1, 3, 4)

Lime is probably the oldest inorganic fertilizer used in fish ponds for amelioration and disinfection purposes. It binds harmful acids (sulphuric, humic, tannic, oxalic, etc.), but also the useful nitric acid which then, in the form of nitrate of lime is not as easily filtered into deeper bottom strata. It also releases other useful substances, such as potash from several of its compounds in the soil and there by also activates the soil. It makes the soil react neutral or slightly alkaline and is useful in the formation of shells of water snails. The fertilization is best made in the fall with the pond emptied and for use in the following spring. Crushed limestone is used to advantage or, if a disinfection is required, also with quick lime or milk of lime. However, it is also possible to fertilize the full and populated pond in spring, with finely ground unburnt limestone. Light and humus soils require 100 to 500 kilograms per hectare. When fertilizing the empty pond with quick lime, it should be left empty for one to three weeks to permit the lime to bind the carbon dioxide of the air.

Phosphorous (1, 3, 4)

As a rule, only traces of phosphorus are found in the bottom of ponds and there-

fore the fertilization with phosphate has almost always been very successful. Phosphorus fertilizers are easily absorbed by the soil. In view of the fact that phosphoric acid and lime form insoluble calcium phosphates, fertilization with lime and phosphates should not be made simultaneously, the former to be made one to two weeks before the latter. The fertilization with phosphoric fertilizers (superphosphates, Rhenania phosphate, basic slag or dicalciumphosphate) should be made in such quantities as to allow 25 to 30 kilograms of phosphoric acid per hectare of pond surface. The fertilization should be done in spring, directly into the water, giving the quantity required for the whole year. It may be done in the populated pond as these fertilizers do not harm the fish.

Potash (1, 3, 4)

Potash fertilization may be done simultaneously with that of phosphates or separately. It is recommendable for sandy or highly humic soils poor in potash. Care should be taken not to reach the harmful maximum irrespective of whether high percent potash or kainite is used. The quantity must be calculated roughly from the potash content of soil and water.

General Fertilizing Rules (1)

The fertilizers should be evenly spread over the whole surface of the pond. Do not fertilize when the weather is cold and cloudy.

Biological Stations (1)

The scientific side for pond fertilization in Czechoslovakia is largely based on the experience gained by the biological and fish pond test stations at Wielenbach, Bavaria, Germany (established 1913) and of the Sachsenhausen, Prussia, Germany, Station.

Literature (4)

The most detailed information on the fertilization of fish ponds is contained in the publication of Dr. R. Demoll "Teichduengung" which was issued in the collection "Handbuch der Binnenfischerei Mitteleuropas, Band IV, Lieferung 1, Stuttgart, Germany, 1925, published by E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Naegele) G.m.b.H.

Note: Just after this report was completed, a very comprehensive article on the fertilization of fish ponds appeared in the October issue (dated September 30, 1937) of the "Mitteilungen des Verbandes der deutschen Grossgrundbesitzer in der tschechoslovakischen Republik." (Union of German Estate Owners in Czechoslovakia), prepared by Ing. Dr. techn. W. Felsykiewiez, Hirschberg a/See.)

Sources of Information:

(1) Dr. R. Pytlik, Chief of the Czechoslovak Bureau of Fisheries and Hydrobiologics.
(2) Czechoslovak State Statistical Office.
(3) The Management of the Czechoslovak Government Forests and Estates.
(4) R. Demoll's Book "Teichduengung".
(5) Czechoslovak Fishers Union, Vodnany.

SLOTS FOR SCREENS AT OUTLETS OF PONDS

By E. D. Brown, State Fish Hatchery,
Rome, N. Y.

PROBABLY NO HATCHERY will ever be constructed in which everything is right. We recently built some new ponds in which we thought we had taken absolutely everything into consideration and they represented the last word in pond construction. But after a summer's operation of these ponds we find that, among some other matters, we slipped up on the construction of the slots for the outlet screens.

Figure I shows how we constructed our slots, the wrong way. In Figure II is shown what we now consider the correct way to place the slots for the screens. No attempt is made to draw to scale in these figures. The arrows indicate the direction of flow of the water.

FIGURE I

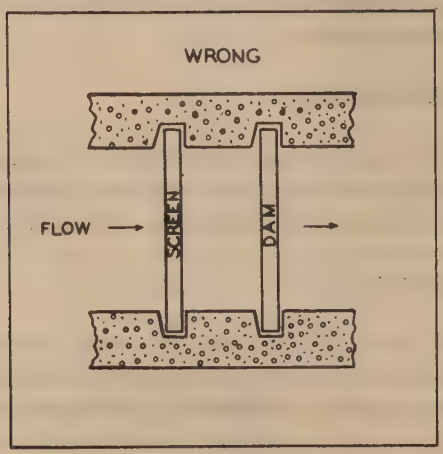
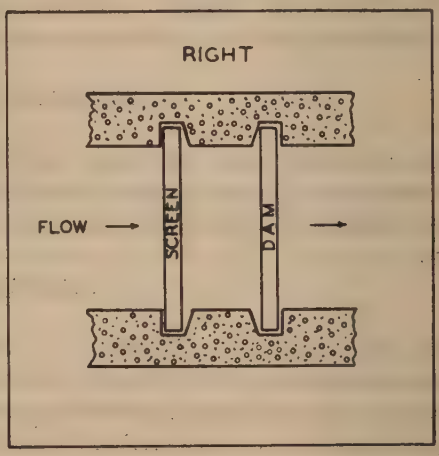


FIGURE II



The first point to note is that all slots are beveled on one side. This makes the construction of the slot easier, and one is more likely to get clean smooth edges in the concrete than if a rectangular strip is used as the form for the slot. However, the chief advantage to the hatchery man in such a slot is that it is easier to slide dam boards and screens up and down in such a beveled slot than it would be in an equally snug rectangular slot.

In the slot for the dam boards the bevel should be on the upstream side. Then the pressure of the water helps hold the boards tight against the flat side of the slots and leakage is cut to a minimum.

We used the same reasoning with regard to the screen slots, and so made them as in Figure I. But now we find that when we clean a pond full of fingerling trout the fish crowd down against the screen, wedge themselves into the angle made by the screen and the beveled edge of the slot, and a great many are killed by the man who keeps the screen clean during the sweeping down of the pond. This crowding down and

wedging in of the fish might not occur in a very long pond, but it does occur in small, crowded hatchery ponds, and in spite of the utmost care exercised by the screen cleaner.

When the slots are made as in Figure II the screen must be held in place by means of small wedges driven in the angle behind it. This holds the screen tightly against the upstream, flat edge of the slot. As a matter of fact, such wedges must be used even with slots as in Figure I or there is danger of moving a screen while cleaning it, thus allowing fish to escape.

With the screen in the position shown in Figure II the fish cannot get their heads into the angle between the concrete and the screen. It is easier to keep them away from the screen during the cleaning of the pond, so fewer are injured. We have been able to prove this to our satisfaction in the case of one of our ponds where, although it was intended that the slots be made as in Figure I, poor workmanship resulted in their accidentally resembling the arrangement shown in Figure II.

Incidentally, the gentlemen who make the blueprints for hatchery construction work always picture a beautifully snug fitting screen and dam. In actual practice we have never been able to fit them so snugly. It is very convenient to have screens and dam boards interchangeable between ponds, and we have never yet seen such perfect conceret work that screens could be interchangeable and all fit with perfect snugness.

CONTROL OF PREDACIOUS INSECTS AND LARVAE IN PONDS

By O. Lloyd Meehean, U. S. Bureau of Fisheries.

FOREMOST AMONG the insect larvae that are known to prey upon fingerling fish are included certain species of dragon fly nymphs and two beetle larvae commonly known as spearmouth and water tigers. The chief culprit among adult insects is the backswimmer (Notonecta). Dragon fly nymphs will be found chiefly where vegetation is abundant and conditions are such that they may be able to live over the winter. The others are ever present when food is abundant in the pond and there is a considerable population of daphnia.

The backswimmer captures bass fry and goldfish up to about an inch and a quarter in length, so the chief damage is done about the time the pond is stocked. Beetle larvae, on the other hand, take victims in proportion to their own size and they may reach two inches or more in length. In this way the damage is spread over a longer period of time and is therefore less noticeable.

So far as the remedy is concerned, the backswimmers and beetle larvae may be grouped together. They are air breathers and advantage may be taken of that fact to rid the ponds of them. Kingsbury (1937) used one part of cod liver oil to three parts of gasoline for this purpose while Langlois (1936) suggested the use of a film of kerosene to prepare ponds for bass fry.

The experiments on goldfish ponds included both kerosene and commercial fish oil. Only a single application was needed for any one pond since the fingerlings, after the first treatment, grew large enough to care for themselves before the insects became abundant enough to do serious damage. Kerosene was used before the ponds were stocked and on the surface of ponds containing fingerlings of various sizes up to about two inches in length. Commercial fish oil was tried only on ponds containing fingerlings.

In no instance was there any serious effect upon the fish where kerosene was used. The insects were killed almost immediately upon contact. The backswimmers came to the surface very soon, but some time elapsed in many instances before the beetle larvae came in contact with the film. Of the various methods of application tried it was found that the best results were obtained by pouring the kerosene along the windward side. Spraying it over the surface of the pond formed too thin a film and killed only the smaller boatmen which are relatively harmless.

Commercial fish oil has a much higher viscosity and may form a heavy obnoxious film which collects on the leeward side of the pond. By spraying only the amount needed evenly over the surface of the pond this can be obviated. Its action is much slower than kerosene since it does not kill on contact, but the insect must entangle itself and thus be cut off from the air supply. It contains no soluble substances toxic to fish.

It was found that ten to twelve gallons of kerosene per acre of water surface were effective. It required four to five gallons of commercial fish oil sprayed over the surface to accomplish the same result. In either case the ponds may be stocked in twenty-four to thirty-six hours after treatment. With kerosene there was some reduction in numbers of daphnia where they were very abundant. It was apparently due to the absorption of the oil by the manure floating at the surface and around the shores, but the daphnia seemed to be as abundant as ever along the bottom away from the edge of the water.

A few individual backswimmers usually fly into the pool almost immediately after it is sprayed, but it takes some time before they again become abundant. No experiments were conducted on the periodical use of kerosene.

References

Kingsbury, O. R. 1936. Foes encountered in the rearing of smallmouth bass. Trans. Amer. Fisheries Soc., Vol. 66, pp. 267-276.

Langlois, T. H. 1936. A study of the smallmouth bass Micropterus dolomieu (Lacepede) in rearing ponds in Ohio. Ohio Biological Survey, Bull. 33, Vol. VI, No. 4, pp. 191-225.

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WPA FISH PROPAGATION PROJECTS WIN POPULAR ACCLAIM

By R. L. MacDougal, Director, Division of Operations,
Georgia Works Progress Administration.

SOMETIME AGO an association of newspaper publishers undertook to find out what was the most popular outdoor sport in the South, Thousands of questionnaires were sent out to subscribers and coupons were printed in the newspapers, requesting readers to list their favorite activities.

When the returns were all in and tabulated, the results were surprising to those who had preconceived notions about the widespread appeal of baseball and football, as indicated by attendance records -- for neither of these ranked first in this unusual popularity contest.

Well, you ask, how about Golf? Tennis, Swimming? Certainly, you say, they are popular pastimes and are growing in popularity year after year. But none of these can be considered the number one outdoor sport in the South.

According to the publishers' survey, fishing and hunting were bracketed together as one sport and voted the favorite of a majority of those responding to the inquiry. It would seem from this that the ancient sport, which grew out of the primitive urge of men, the quest of food - has maintained its popularity in the South in spite of the tremendous advance of the more recent forms of recreation.

This may account, in a measure, at least, for the growing public interest in the South in the conservation program of the Federal Government. The conservation of natural resources is recognized as a legitimate function of the National Government.

In recent years the policy has been broadened to take up a variety of new activities. The protection and development of wild life come within the scope of this policy. It, therefore, was logical that conservation projects of this type should have been included among those approved by the Federal Government for prosecution in cooperation with state and local authorities when the work relief program was inaugurated.

Conservation projects carried on in Georgia under the FERA and WPA work relief programs have been directed mainly toward providing facilities for the restoration of our fish and game resources. With the use of relief labor seven fish hatcheries and a game farm have been built at a total cost of more than one hundred thousand dollars of Federal and sponsors' funds.

Five of the hatchery projects were spronsored by the State Department of Fish and Game, now the Division of Wild Life of The State Resources Department. Two are strictly Federal projects.

The State Hatcheries are at Summerville, Magnolia Springs (near Millen), Bowen Mill (near Fitzgerald), the Henry Ford Hatchery, (in Bryan County), and the Tuft Spring Hatchery (near Macon).

The Federal Hatcheries are at Warm Springs, in Meriwether County, and Lake Park, in Lowndes County.

Mention of the name of Henry Ford in connection with a fish hatchery naturally creates curiosity as to the reason for the designation. The answer is that the Detroit motor manufacturer, who has a vast estate near the Georgia Coast, donated seventy-five acres of land to the State as a site for the hatchery which bears his name.

The potentialities of these plants as sources of fish for restocking purposes are indicated by an estimate of the Wild Life Division of the Resources Department that the four state hatcheries now completed - Summerville, Bowen's Mill, Magnolia Springs, and Henry Ford - are capable of producing eleven and a half million fish annually. The last mentioned hatchery is the largest in the state group. It will have a capacity of about five million fish. The figures quoted, of course, do not take into consideration the production possibilities of the two Federal hatcheries - Warm Springs and Lake Park.

As one who enjoys goin' fishin', and as a member of the WPA staff, I have been deeply interested in observing how these facilities are being utilized by the State.

The Summerville Hatchery is producing Loch Leven and rainbow trout and Kentucky bass.

The Bowen's Mill Hatchery is producing bass, red breast and white spotted perch.

Magnolia Springs is producing bass, red breast and red fin perch.

The Henry Ford is for bass.

The Loch Leven and some of the rainbows in Georgia streams may trace their origin to distant states; for, as we are told, the former are from eggs obtained from the Bureau of Fisheries out in Minnesota, and the latter are from eggs brought to Summerville from Virginia.

Some rainbow were released in the mountain streams of north Georgia this season.

The Tuft Springs unit is being used as a rearing pool for bass and, we are told, now contains more than one hundred thousand little fellows.

More than one hundred and fifty thousand fish from these hatcheries have been released and there are two hundred and fifty thousand in rearing pools.

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Through a cooperative arrangement with the Federal Hatcheries the State forces are distributing fish from the hatcheries at Warm Springs and Lake Park. Officials of the Wild Life Division envision the release in the public waters of the state of between eight and ten million fish of all varieties from the State and Federal hatcheries this fall. So, Georgia fishermen who may not have been able to take the limit on any trip this past summer have reasons to view the future with even more optimism than is characteristic of the tribe.

OBSERVATIONS OF INTEREST TO HATCHERY MEN

By Edward R. Hewitt, New York City.

Fin Rot Eliminated by Continued Tank Sterilization

FIN ROT is one of the most troublesome things in raising trout and I have had my fair share of it. Up to this year I had not found any means of completely avoiding it or curing it. In my own hatchery I have a very small supply of spring water. Hence it is necessary for me to use round metal tanks for rearing fry and small fish because by this means I can get along with only one or two gallons of water per minute per tank. I have under twenty gallons for the whole hatchery. It is found that the oxygen supply is ample for these small fish, and the current can be made anything desired. With this small flow, dirt and foreign matter are not as well removed as with more water, although it is all carried to the center outlet. The surfaces of the tanks which were coated with Bakelite enamel, became covered with a slimy fungus coating which was invisible but could be felt with the fingers. No amount of scrubbing completely removed it. An experiment was made to clean it off with chlorine. A 5% solution of H.T.H. hypochlorite of lime was used, and the amount determined which would make a sample of the water show a brownish yellow when 1 cc. of orthotolidine was added to 50 cc. of the water. The tank was stirred a few minutes and the chlorine neutralized with a 5% solution of hyposulphite of soda, using the same amount as of the hypochlorite solution. The tank was stirred and the orthotolidine test showed no color. If it does, a little more hypo will remove the color. This water is then harmless to trout and can be run into pools containing fish with no danger. Of course all trout must be removed during the sterilizing process.

It was found that the fungus generally reappeared in about two weeks. The tanks were therefore treated every two weeks. It was soon noticed that the fin rot disappeared and there has been no fish with it in the hatchery where this has been done in eight months, whereas there had always been many cases all the time before. Dipping never completely eliminatedthe fin rot.

I might say that my 4 ft. round tanks are elevated from the floor about twenty inches and are provided with a 2" hole at the outer edge closed by a rubber cork. When trout are to be removed from the tank the water is lowered to about two inches deep, the cork removed, and the fish caught in a net, none being injured. The tank can be emptied of fish in a few minutes.

It looks as if the fungus spores or threads adhered to the slime of the fins and in some way provide an entry for bacterial infection. This is the only explanation I have been able to think up. If there is no fungus present I find that there is no fin rot in my fish, and this is the only way I have succeeded in eliminatin it entirely.

Milky Water from Feeding Liver

In feeding finely ground liver to small fry and fingerlings the water usually becomes milky and this has a great tendency to reduce the oxygen through oxidatio of this widely distributed organic matter. When finely sieved kelp meal is mixed with the ground liver in the proportion of about 5% before feeding the water is only made very slightly milky and if the feeding is done slowly the water remains clear.

Dipping

Dippings recommended for a number of trout diseases and also for removal of surface parasites. Different dips are used for various purposes. In order to simplify the question of diagnosis, and also to be sure that everything would be treated at one dipping, I have adopted a combined dip which treats all the external parasites and diseases at the same time. It was not difficult to do this as the chemicals used for the various dips have no reaction on each other. My dip is composed of a 3% salt solution to which is added 1 to 2000 copper sulphate and 1 to 500 glacial acetic acid. Small trout are dipped from 3/4 to one minute and fish over 6" from 1½ to 2 minutes. It is most important that the solution be well aerated if more than one lot are to be dipped in the same bath. I have never killed any trout with this dip which seems to do all that any single dip will do for the various troubles. This is the most valuable and satisfactory trout treatment I have yet seen.

Zinc in Trout Waters

It is well known that zinc is toxic to trout, but I have not seen any statements that a very minute amount may cause serious trouble. This was brought to my attention because I had a wooden round tank which received its water from a pipe 230 feet long, 10" diameter which was made of lap welded and galvanized steel. As this pipe had been in use for four years before it was placed in this position and was rusted inside, it was thought that the zinc had been oxidized away and would do no harm. For three seasons small trout were placed in this tank and after a month or six weeks they always got fin rot or ulcers or fungus and the mortality was always great. The next tank showed less trouble while the fourth tank receiving this water in succession had almost no diseases or mortality. An analysis of three liters of evaporated water

disclosed decided traces of zinc and some iron. As nothing else seemed to account for the trouble I removed the iron pipe and replaced it with a wooden box painted with Everjet black paint. The fish began to get better in a few days and a new lot placed in this tank did not show diseases as formerly. Another pipe 130 feet long when replaced showed the same results. It is evidently not safe to have any zinc surfaces in contact with waters used for trout. Even small lengths of pipe should be treated inside with Lithoform and painted with two coats of Everjet. This makes the pipe safe for trout.

The water at my place is soft and has a p H of 6.8 and about 2-4 parts C02 per million. These same results might not occur in alkaline waters.

COMMENTS FROM OUR READERS

SMALL-MOUTHED BLACK BASS SHIPPED TO SOUTH AFRICA

Editor, Progressive Fish Culturist

Sometime ago you asked me to write you concerning a shipment of small-mouthed bass which we made to The Cape Piscatorial Society, Cape Town, South Africa.

It may be of interest to you to know how the contact for the shipment came about. I shall start from August 1934, when Mr. L. A. Day, Inland Fisheries Officer, Department of Fisheries, Union of South Africa, visited the United States for the purpose of gathering information with regard to hatching and rearing both bass and trout. He visited quited a number of the U. S. Bureau of Fisheries stations and also our hatchery and rearing ponds at Lewiston, Maryland. He became very much interested in our method of small-mouthed bass operations. That was the first year the nesting stalls were operated. Knowing the qualities of the small-mouthed bass, Mr. Day asked if we would consider making a shipment of them to his country, provided his department paid all expenses incident thereto and returned the equipment to us. From that time until October 1935 considerable correspondence was carried on with Mr. Day; Dr. Cecil Von Bonde, Scientific Department, Capetown; Mr. Cecil Harrison, Inland Fisheries Advisor, Capetown; Mr. B. Lambooy, Commercial Attache, Union of South Africa, Washington, D.C.; and the American South African Steam Ship Company, Inc., New York. Mr. A. M. Vide, Chief Radio Operator, M.S. CITY OF NEW YORK, was in charge of the shipment during the voyage.

On February 1, 1937 we made the first attempt by shipping six metal cans, 24 inches in diameter and 10 inches deep, completely insulated with peat moss except for the 12-inch diameter lids. Small airpumps were provided to supply oxygen which

was broken through rotten stone filters. Upon arriving in New York we found, three hours before sailing time, that we had been misinformed as to the current used on the ship; instead of 110 AC current the ship used 110 DC current. We immediately contacted the ship's electrician and learned that an instrument converting DC to AC current could be used, but he did not know where one could be procured. However, we did learn of an electrical supply house in Manhattan which carried them, so away we went from Brooklyn to Manhattan. After asking everyone from policemen to street cleaners, we finally found the place, only to learn that the equipment we needed would have to be ordered from Chicago. After more hurried questioning, we located another electrical supply house that had a used instrument for sale at what they called a cheap price. We had no time for argument so made the deal and got the equipment hooked up before sailing time.

After all of this excitement the ship sailed. Knowing that it would not dock at Capetown until the 22nd, we could do nothing but wait. The following message was received the latter part of March: "All fish died five days out."

Analysis showed that zinc has leached from the metal cans, although they had been coated. Later I learned that the airpumps had been disconnected at night because our equipment had interfered with the short-wave reception of the guests' radios.

A request to duplicate our efforts was made.

Having failed the first time, we studied the conditions which had to be overcome. Finally, we decided to construct cypress tanks 3' x 3' x 16" with flanged tops, leaving an 18-inch square opening, mortised together, no nails or metal to be exposed inside. Six such tanks were constructed, each holding 90 gallons of water to the required height.

We then obtained two 3½ cu. ft. p.m. diaphragm airpumps equipped with 1/4 H.P. DC motors, which could pump 40 pounds of air pressure if necessary. These pumps and motors were mounted on a panel and arranged so that they could be worked either together or separately. Should any one unit become disabled, a second one could take its place. Additional diaphragms, pistons, etc., were provided for emergency repairs.

A 3/8" rubber airline was supplied to the tanks and the air supply of each was controlled by a valve. Beyond the valve a rubber hose ran to the bottom of the tank, where it was inserted in a 2" x 2" basswood block held down by a piece of cloth fastened to the bottom with two large tacks. The only metal exposed in the tanks was the two tacks and the flanged drain plugs.

At 12:30 A.M. on September 28 the tanks were filled with water from the Lewiston hatchery. Eight 4-inch small-mouthed bass were placed in each of four tanks and nine of the same size in each of the two remaining tanks. They were transported by truck to New York City and at 11:00 A.M. on the same day were loaded aboard the M. S. CITY OF NEW YORK, operated by the American South African Steam Ship Company, Inc. After all connections had been made and the air pressure set at 10 pounds, the consignment was put in the immediate care of Mr. A. M. Vida, Chief Wireless Operator of the vessel. The boat was due to arrive at Capetown on October 22. On the morning of the

25th the following radiogram was received: "Capetown, October 23: - 26 bass arrived yesterday shipped Capetown all looking fine this morning at hatchery. Mortality first 12 days out. (Sgd.) Harrison." I might add that there was no change of water during the trip.

I was very much pleased to receive this encouraging message and to know that we had made the first successful importation of game fish from North America. Most gratifying of all, however, was the fact that we had given to people less fortunate an opportunity to have the greatest sport fish that swims - the small-mouth bass.

A. M. POWELL
Superintendent of Fish Hatcheries
Maryland Conservation Department

FERTILITY OF WATERS DETERMINES FISH SUPPLY.

Editor, Progressive Fish Culturist:

Let me commend Mr. W. T. Combs for an interesting article and the presentation of three important problems for consideration in the June issue of the PROGRESSIVE FISH CULTURIST.

I was particularly interested in problem number one, as I have always considered that the production of natural food and the general improvement of natural conditions were more important than propagation.

Although I am entirely in sympathy with his idea of more natural food, I wish to point out that in my opinion he has answered his own question there in the parenthesis of the closing lines of the paragraph. This was, "Water analysis and temperature being favorable." Granting him this, the food supply would be there. Consider his illustration of turning cattle on a barren pasture; why was the pasture barren? Evidently because of a lack of fertility, which of course is mineral salts, water and carbon dioxide. As plants are the basic food supply of all animal life, including Mr. Comb's proposed crustacae plantings, it naturally follows that the same thing would happen to the crustacae as would happen to the cattle.

Although the idea of more natural food is a good one, I think that we will have to go further down the cycle for a remedy. For, just as we will find good grazing on all fertile lands, whether artificially introduced or not, so we should find good grazing in all fertile waters.

Here it might be well to consider the relationship of aquatic plants to oxygen supply and their bearing on fish life for I am well aware of the possibility of an

over supply of plants especially in shallow areas, with a corresponding drop in dissolved oxygen along about the wee hours of morn, often with a fatal result to the fishes present.

My point is however, why are newly impounded bodies of water always abnormally productive during the first three to five years? I would suggest that it is because decaying vegetation causes bacteria, giving the same result we get in fertilizing our brood and nursery ponds.

This takes us back to my first statement. Broadly speaking when we improve natural conditions, all these things will follow. It is true that there are notable exceptions, but after all a few ounces of tobacco seed would furnish enough cigars for all the anglers in a nation if the seed should all germinate and the plants attain their maximum growth.

Put me down for conservation, stream survey and improvement, and flood control. Also, rescue work, protection from pollution, soil erosion, and preventing game law violations. Then let propagation follow and not lead all other fish cultural activity.

I don't think much of that idea of dynamiting trout waters, at least the idea of planting trout in said water the following day before any survey or analysis was made of the water to determine what effect the shock had on the food supply.

It has been my observation that of all the vocations, the average public has the least conception of fish culture. They think that a can of fish plus water equals angling regardless of when, where, how or what amount. A little more enlightenment would do us all good.

J. Q. McGee, In charge,
U. S. Fishery Station,
Norris, Tenn.

REVIEWS

THE SALMON-TROUT FAMILY

A Review of "Die Lachsartigen" (Salmonidae) Part I. by E. Neresheimer. Handbuch der Binnenfischerei Mitteleuropas. Vol. III. No. 5, many tables, 42 illustrations, plates VI-IX, pp. 219-370. Stuttgart 1937. E. Schweizerbart'shce Verlagsbuchhandlung.

A BOOK of a hundred and fifty pages dealing with a subject as broad as this must be, of necessity brief in order to give each group a fair treatment. Nevertheless an explanation of the conditions and problems of salmon and trout in Europe as presented n this work should be found very enlightening to the American fish culturists. It is evident that the author has perused most of the American literature on his subject, but no attempt was made at a complete bibliography. Still, the reader will find a striking number of references to obscure European journals which are rarely brought into our literature.

Dr. Neresheimer's discussion of salmon (Salmo salar L.) is by far the most thorough part of the book. This division is initiated with a short review of the anatomy, life habits and development. He augments this with a treatment of their sense organs, migration impulses, reproduction, artificial culture and sex distribution (percent females and males). Considerable emphasis is placed on the economics of the salmon industry. In addition he considers the influence of canals, pollution and dams on the salmon industry. It seems that the construction of dams in European rivers is considered a factor that threatens the life of the industry. Salmon are already being imported from the Pacific to meet the needs of the market.

Many interesting features of salmon migration are brought out by the author. He quotes from Zschokke and others on the distance made by European salmon in a day. The figures vary from 12 to 50 km. per day. Other bodily attainments of migrating salmon are discussed. He tells of one interesting incident of migrating salmon where they were frightened from the mouth of the Elbe River by the war manoeuvers, directing them into the neighbor river, the Weser.

In the discussion of artificial culture reference is made to Scheuring's experiments with trout spermatozoa and his success at keeping them alive at low temperatures (above zero C°) in an undiluted condition for as much as 10 days, moreover they were shipped in this condition and successfully cultured in distant parts of Europe. This procedure was found particularly advantageous due to the shortage of males in the culture stock.

Rainbow trout introduced from America appear to have found universal adaptation in almost all types of European waters which vary from semi-warm ponds where fish are cultured for the market to the cold Alpine lakes and streams of Switzerland and Austria. The introduction of the American lake trout Cristivomer has not been successful.

In regard to the Steelhead, Scheuring's comprehensive review of fish migrations is quoted as saying that this fish weighs from 4-7 kg. when it leaves salt water and the maximum recorded was 20 kg. Young trout are 2½ to 4 years of age when they leave fresh water and their marine sojourn there lasts some 2 years.

Of the trout, the brook trout receives most emphasis in this work. The topics consider such material as variability, distribution, habits, spawning season, culture and disease problems and economic importance.

Arthur D. Hasler.